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OBSERVATIONS ON URBAN TRANSPORTATION<sup>a</sup>

By Luther Gulick<sup>1</sup>

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SYNOPSIS

Economical urban transportation systems to meet the present and future circulation demands of the urban complex must evolve through comprehensive analysis, research, and design based on an understanding of the function in and significance to the urban center of these systems. The complex factors involved in the economics of urban transportation are considered herein from the point of view of the urban public administrator and researcher. Reasons for the development of the modern urban area, the function of urban transportation, and causes for concern with urban transportation as a current problem are discussed. The theaters of decision crucial to urban transportation are analyzed in terms of the compelling economic considerations involved.

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FORCES WHICH PRODUCE THE MODERN URBAN AREA

If the 32 black and white pieces of a chess set were scattered throughout a room and assumed to have strong reasons for conferring, working together, or dealing with each other, a simple picture is formed of the forces that create urban centers and of their transportation problems. The initial response of the chessmen to wide scatteration would be the attempt of certain pieces to come together. For some reasons the bishops might want to be close together, as

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<sup>a</sup> Based on a paper read before the ASCE convention in Boston, Massachusetts on October 13, 1960.

<sup>1</sup> President, Inst. of Public Administration; New York Dir., Metropolitan Areas Project, Edgar Stern Family Fund.

might the knights or the pawns. For other purposes one queen would want to be surrounded by knights, and a bishop would certainly want to shepherd the black pawns. The kings would move with their castles, and the knights, after occasional forays, would return to their kings. The only way to fulfill these kaleidoscopic desires and needs is to assemble all of these pieces in the closest possible compass which still permits changes in their interrelations from time to time. The answer cannot be found by packing the pieces in a box, for they must always have the opportunity for further movement.

Such is the bipolar force that creates the modern urban center. The human being is a social animal, as Aristotle observed over 2,000 yr ago, and is by nature a teamworker. He cannot do a great deal in isolation, but there are apparently few limits to what he can accomplish working with others. For this reason there is no limit to the need, the desire, or the economic advantages of bringing human activities close together in a fluid teamwork matrix.

Crowding humans together in a restricted geographic area is the first and most direct method of producing that matrix. The whole purpose of the urban center is to reduce the space that separates men without freezing their relationships. Crowding, however, creates attendant problems for human beings, problems of health, of comfort, and of aggression. Costs of living mount as the requirements of sanitation and other considerations multiply. Furthermore, as congestion makes movement difficult, crowding can produce a physical obstacle to easy communication, except with one's immediate neighbor. Thus, crowding itself can defeat the basic function of the city which is facilitation of communication with various people selected at will.

In response to the bipolar forces engendered by the need for close human association and the problems adherent to physical crowding, three adjustments have occurred. The first makes crowding livable by controls, services, and amenities. The second makes crowding less necessary by creating methods of mechanical human communication which do not require immediate physical propinquity. The third speeds and mechanizes circulation, enabling more distant neighbors to work together or exchange goods without significant expense or loss of time. This last is the transportation system. Each of the approaches—controlled urbanization, indirect communications, and transportation—makes its contribution, and each has its limitations and costs.

Cities have from the earliest times done a great deal to gain the benefits of close human association and at the same time to mitigate the unhealthy and undesirable effects of crowding by planning, zoning, sanitary and health services, police and fire control, and by prohibiting acts which encroach upon the freedom of others. They have made a place for the special architectural instruments of close association. There is, nevertheless, the problem of diminishing returns in human crowding when people become so closely packed that they cannot move about easily in their various and changing activities and errands.

Mechanical and electrical communication devices have also made an incalculable contribution. The newspaper, telephone, radio, and television spare many trips, meetings, and personal encounters. The extraordinary progress, the increased dependability, the magic of modern communication which are now taken for granted, have gone a long way to wipe out space for a certain range of human contacts. The time loss involved is virtually negligible, and the unit costs of modern communication are minimal.

The drawback in substitution of mechanical and electronic communication for direct personal communication is the limitation imposed on the range and

accuracy of the sensory impacts which are thus conveyed. This loss is partly due to our limited vocabulary and instrumentation, and partly to the scope of unreflected subtle impacts of the human personality. In spite of the extraordinary progress over the past two decades, especially in the combination of direct sound and photograph, no communication system is sufficiently Hi-Fi to reflect the more subtle human relationships and activities, nor to treat all situations with equal impartiality. Mechanical communication can obliterate space for a certain limited range of habitual sounds, images, facts, and decisions, but it cannot obliterate space for the direct physical factors and for certain intangible psychic values. Therefore, when interaction between direct personal impact and the indirect modes of expression is required to convey the full sensory significance of communication, any indirect intercommunication process is inadequate. Further, indirect communication introduces the powerful and distorting factor of selection, that is, editing by someone, or "something," other than the "communicators."

Although the transversions thus produced may not be too important in the humdrum relations of life, they are important in the most significant human relations, particularly those relating to leadership, to processes of social agreement and decision, to habit changes, to invention and creative work situations, and to the highest contributions of mind, spirit, and friendship. Even with the progress that still lies ahead, the electronic devices will never catch up with the full multi-dimensional physical and spiritual reality of the human personality. Man uses machines, and thus continuously rises above and beyond them, however beautiful and clever they may be.

As a result of the inherent limitations of mechanical and electronic communications, one must conclude that such devices cannot take the place of massive urbanization. For some essential purposes, densely packed human concentrations will always be needed.

### FUNCTION OF URBAN TRANSPORTATION

The persistent need for human concentration and the stultifying effect of congestion make the third method of adjusting life to urban crowding, namely the transportation and circulation system, basic to civilization. The function of this system is to overcome space as a barrier without destroying space as a channel of free and changing contact.

Physical transportation makes it possible to reach across space to bring together varied combinations of persons and things. The comprehensive circulation and transportation system includes everything that is used in this process. Under this definition, sidewalks, elevators, escalators, hoists, loaders, pipelines, tubes, wires, conveyor cables and belts, pushcarts, and even sewers are just as much a part of the total system as are streets, free-ways, bridges, railroads, tunnels, canals, subways and elevateds, buses, private cars and trucks, airways and airfields, garages, terminals and port facilities, and all the equipment used in and on these facilities and their rights of way. Too often overlooked is the vast intermeshed complexity of the total mechanical and institutional structure man has evolved over the centuries to master space.

The great advantage of good transportation as a method of overcoming space is that it physically brings together persons and things. Intervening space can

be squeezed out while the freedom to move and to establish new contacts is preserved. Humans who reside at some distance from each other can work together, bargain, argue, compromise, and agree as though they were direct neighbors. With good transportation, man can have a thousand neighbors, or a hundred thousand, or a million, with all the added choices and teamwork possibilities afforded by this widened horizon. Goods can be seen and exchanged; raw materials processed; components assembled; and commodities distributed and consumed.

The great disadvantages of transportation reside in its consumption of time and scarce resources, and its potential to destroy not only the space which it seeks to master, but also the freedom of further movement which must be preserved. It is at this point that the problem of urban transportation begins.

It is useful to recognize two major categories of transportation in each large urban concentration, the external transportation system and the internal system of circulation and movement. The two are related at their meeting point, neither being fully effective without the other. In considering the internal circulatory needs of an urban area, however, and action to meet them, the distinction serves to clarify, and to shift focus from consideration of the railroad commuter problem, for example, in relation to the national railroad system, or of the interstate highway system in its total pattern, to consideration of both in terms of their impact on the local circulatory system.

The function of the exurban transportation system is to link the urban areas to each other and to their rural and resource hinterland. The function of the internal urban circulatory system is quite different. It is to capture the advantages of compounded human crowding, thus extending infinitely the probability of fruitful contacts and creative teamwork, while preserving the maximum freedom of choice in these contacts.

This definition of internal transportation appropriately places the emphasis on human beings rather than on commodities. Because urban concentrations are formed today for human purposes and advantages, our first problem within the urban area is one of human contact and circulation. This fact is obscured by examples from the past when the material requirements of defense, trade, and labor were compelling because of the limited ability of external transportation and communication systems to bridge great distances. Henry Fagin has rightly called attention to the relation of transportation and the division of labor. The important aspect of this relation is, however, not the movement of material components, but the social structure of co-operating specialists and interrelated "external economies" arising out of the human phenomenon of specialization. Today any major self-contained manufacturing establishment with minute division of labor can be taken out of the urban area with little loss and great gain to the establishment and its routine employees. Each such enterprise is an integrated, rationalized, "closed" economic and social system with its own pattern of internal and external transportation. It, in itself, is not an essential component of the "fluid teamwork matrix" of human concentration today. While the movement of commodities is essential to the urban concentration, it can interfere with required human circulation. Therefore, while goods movement within the urban area cannot be omitted from consideration of the total internal system, the prime consideration is the circulation of people in the "open" social and economic matrix of an urban area with no fixed structure but with infinite pluralism. It is the function of the internal

transportation system to make this kind of fluid human life fully viable in the vast urban environment.

#### CAUSES FOR CONCERN WITH URBAN TRANSPORTATION TODAY

Great concern with urban transportation today grows out of the fact that the ecological equilibrium between human concentrations and the internal urban circulation systems established over the past century has now been thrown out of kilter. The imbalance came about suddenly because of an extraordinary combination of circumstances after World War II, including a phenomenal growth of our population, the formation of millions of new families, a marked change in income distribution, universal ownership of the automobile which has been improved and endowed with heightened "status appeal," lack of acceptable city housing, and artificial stimulation of suburban housing. The combined effect of these developments has had major impact upon the patterns and transportation needs of metropolitan areas:

People have scattered out into the country for residential accommodations although they want to continue to work for city corporations, shops, and factories and in city professions and trades. This movement has created a scattered urban population and reduced the density of the population in the city, leaving it with a higher proportion of the economically handicapped.

From their scattered homes, these people start to work in their private cars and prefer to finish their trip without changing to other modes of transportation. Thus, road traffic is increased and mass transportation reduced.

Many factories have moved to cheaper and more available space outside the city where they can now find ample labor traveling to work by car, and can handle their goods by truck. Employment opportunities in town are correspondingly reduced.

Shops and shopping centers depending upon auto and truck transport have also developed in the suburban region. Trips to town and business in town are thus cut down.

Professional and service trades have followed the population which commands buying power. The people engaged in these trades travel to their new work sites by car.

Fine new highways have been built in the suburbs along with thruways, bridges and other conveniences for automobile traffic. Garages and parking lots are being provided in town. Mass transportation within the urban center has lost business, lost income, reduced service, failed to modernize, and generally lacked imagination and understanding of what is happening.

These developments have occurred concurrently with the shift to a five-day, forty-hour week which has eliminated Saturday and Sunday business for common carriers and heightened the peak-hour loads each workday. Improvements in radio and television have revolutionized entertainment in the home and further reduced non-peak-hour passenger travel.

As a result, the urban circulation system, evolved for totally different conditions, cannot now perform its twin responsibilities. It can bring people and things together, but not without inordinate time delays. It cannot, then, preserve the freedom of movement and contact required. In other words, the basic function of the urban concentration is now threatened by the breakdown of the internal circulation system. This is the first reason for concern with urban transportation.

The second reason arises from the knowledge that nothing will set the pattern of the future for any town so irrevocably as the major outlines of the transportation system which is now adopted and installed. There was a time when transportation was designed to meet the needs for movement generated by land uses. This is not the situation today. As John T. Howard has said, "Over the long run, the relationship reverses. Future locations of land-uses largely result from the circulation system and its impact."<sup>2</sup>

The sequence of land development under present conditions in a metropolitan area appears to exhibit six clear steps:

First, the extension and marked improvement of all-season, limited access passenger and freight highways;

Second, the "development" of land, thus made accessible, with both high and middle income suburban housing, and the proliferation of shopping centers, factories, and warehouses;

Third, the extension of electricity, telephone and other utilities in pace with or just ahead of development;

Fourth, the establishment of local services and service trades along with spotty location of lower income housing, developing partly by conversion and partly by new construction;

Fifth, a frantic and not too successful effort to catch up with required governmental services, particularly sewers, schools, water supplies, paving of secondary roads, and parking facilities. Policing, fire protection, health, education and welfare services, and recreational facilities are equally involved;

Sixth, as the secondary roads are built and services extended, more land is rendered "ripe for development," and the cycle repeats itself.

Such a sequential spiraling cycle is not entirely new. It occurred when streetcars were introduced and again when rapid transit developed. The current cycle, which is based on ubiquitous ownership of automobiles and trucks, triggers an initially less dense but far broader pattern of settlement.

The initial situation produces highly desirable suburban opportunities. It may be, however, a transitional delight destined to deteriorate sharply as the land fills in, the highways become congested and slow, the open spaces disappear, the governmental facilities continue to lag behind the needs of the developing population, taxes rise, land values for single family houses climb out of the reach of the middle income class, and high-rise apartment and other buildings begin to be built in the nodal centers to effect an increase in earning power of the land. After these developments, highways which were a joy for the first settlers will be a headache for the third wave of settlers, and the costs of added thruways will be prohibitive. There will then be suburban slums which do not have the power to save themselves, and an urban concentration which cannot be sustained because of the collapse of circulation.

The third reason for concern with urban transportation lies in the recognition that most urban centers are blundering into solutions of urban transportation with no real knowledge of the overall significance or results of the action being taken. It can be suspected that much of the action relates only to superficial symptoms, and may make matters worse in the final analysis. This situation is particularly disturbing in view of the fact that land uses and urban efficiency for the future rest directly upon, and will be limited by, the circula-

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<sup>2</sup> "Integrated Planning," by John T. Howard, *Traffic Quarterly*, Vol. XIV, No. 4, October, 1960, pp. 421.

tion and transportation framework set down today. Under modern conditions, those who lay out the urban circulation system determine much of the pattern of future civilization.

### ECONOMIC CONSIDERATIONS AND THE DECISION PROCESS

In modernizing the urban circulation system one must obviously be controlled by the basic urban function, namely to increase the opportunity for human contacts and at the same time to preserve freedom of movement. Economy both of time and cost is highly important in this endeavor.

The nation's urban regions, with their cities and suburbs, are eternally in competition not only with each other, but with other sections of the world as well. If a city has a wasteful transportation system, the inhabitants of the area will eventually have to accept a lower net income and attainment of fewer of the things that they desire than they might enjoy in a region with an economical transportation system. Transportation is surely an area in which the "inequities of the fathers will be visited upon the children unto the third and fourth generation," as the Bible says.

There is not much a city can do about the efficiency of its external transportation ties as these are determined by the natural advantages of the city and by the national and international transportation system. The great differences between cities that have equally good locations will thus arise from their own internal transportation systems, their own docks and terminals, their flow of internal traffic, the efficiency of their pattern of arrangement, and the time costs involved in the use of their circulation facilities.

Many people concerned with urban transportation today are convinced that the transportation system of the future should be designed to fit a straight line projection of present origin and destination linkages. Origin and Destination (O & D) studies have consumed millions of dollars in recent years. Even some engineers bow down before the idol of O & D. This gives them a comfortable religion, a substitute for creative planning and thought. Every O & D study is a picture of the past. It is powerfully determined by the existing traffic linkages, linkages which are inadequate and irrational in terms of modern conditions and needs as has been pointed out. Such projections usually extend the past into the future to create a picture to be avoided rather than one to be embraced. Sample O & D studies can be of value for the development of trends and interrelations, but planning for the future must start with an idea of the desirable future and work back. Such a normative perspective enables the community to guide traffic-generating land use, to modify the circulation system, to create new transportation facilities, and to establish by economic incentives the individual demand lines of a future convenient and economical set of linkages.

It is thus appropriate to inquire into how the major decisions affecting the future transportation and circulation systems of the fast developing urban concentrations are being made. It is clear that the "great decisions," those which will mold the urban communities for generations to come, are being made in four distinct theaters:

The first is at the federal and state level, largely dealing with new limited access through highways. Also involved on this level of decision are airports (federal); interstate commerce controls over rails, water, and trucking

(federal); harbor and navigational maintenance (federal); slum clearance, urban renewal, and public housing (federal, state, and local).

The second theater of decision is the flow of individual trips made by people and goods from hour to hour, and day to day. These decisions are almost entirely individual and personal. The grand decision in this theater is the accumulated sum of private acts.

The third area of decision relates to the governmental allocation of scarce resources locally, including the determination of how much land within the urban region shall be devoted to exclusive rights of way, to terminals and to vehicle storage.

The fourth area of decision comprises the decisions, public and private, which set the general character and volume of urban circulation needs and demand by determining or guiding the traffic-generating land uses.

An examination of each of these areas of decision yields knowledge of the controlling forces and the directions in which they are guiding urban building for the future, and thus may clarify the significance and consequences of the solutions being reached.

Decisions of the top level are made by the federal government and by the states, at present primarily through the massive interstate highway program. This program was undertaken for "natural defense," for the prevention of "tragic and costly accidents," and for the "modernization" of the obsolete intercity highway system.<sup>3</sup> The federal interest in air, rail, and water commerce has been and will inevitably continue to be primarily concerned with the external commerce of urban areas, although several congressional committees have recently become involved in urban commuter problems. Connery and Leach, after a comprehensive review of present federal impacts on the urban areas observed that "as the federal government has become involved, it has proceeded on an ad hoc basis, its many parts moving independently most of the time without any attempt at coordination."<sup>4</sup> Thus, at the top level, decisions are made program by program with only incidental attention to the interrelations of federal, state, and local activities.

Decisions at the next level rest with the users. They are continuous, highly visible and vigorous forces; people and goods must always move. They are determined by the personal convenience and direct cost to the user of each trip or shipment. This phenomenon of arriving at an economic answer by taking the result produced by millions of free individuals is known as "the market." It would be a wonderful way of discovering what kind of transportation system a city needs provided that (a) there is in fact "a free market" as to circulation; (b) a community can freely experiment with a system, discard it and try another; and (c) the charge for each individual service reflects the true costs. The fact is, however, these conditions are not met at any point. The market is not free; transportation tends to be a monopoly, each mode in its own sphere. Further, once a major type of transportation is laid out, little can be done to change it radically for fifty years or more. The user cannot "shop around," freely experiment, or test. He must select from the modes of movement and equipment provided, however obsolete.

<sup>3</sup> "A Ten Year National Highway Program," Report to the President, the President's Advisory Committee, Lucius D. Clay, Chrm., U. S. Gvt. Printing Office, Washington, D. C., January, 1955.

<sup>4</sup> *The Federal Government and Metropolitan Areas*, by Robert H. Connery and Richard H. Leach, Harvard University Press, Cambridge, 1960, pp. 61.

But the primary problem adheres to pricing. There is hardly a mode of urban transportation in connection with which the user knows the actual cost of a trip to him or to the community of which he is a part. In some cases rates are higher than are economically required, while in others they are distinctly lower. In New York City, the man who crosses the Triborough Bridge helps pay for the Coliseum; the Holland Tunnel user helps finance the Narrows Bridge and docks in Brooklyn; the man who takes the inter-airport helicopter benefits by a federal subsidy of \$3.00 for each \$1.00 he pays; the New Haven Railroad commuter is subsidized out of freight rates and the pockets of the stockholders; the subway rider comes over a right of way furnished by the real estate taxpayer; and many a man drives his private car over a bridge financed by local real estate taxes and stores his car all day on public streets, all for not more than the cost of his gasoline, a third of which consists of taxes collected by the state and the nation.

It is thus an understatement to say that urban transportation is not in the "free economy." It is an area of managed prices, some of which are loaded and some of which are heavily subsidized. It is difficult to find a single transportation service of which the charges reflect the true cost. This chaotic situation is not, however, the result of any thought out plan or policy. It has arisen almost by accident and has been deeply affected by the shifting waves of historical development and public opinion.

The point at which the free market price breaks down most conspicuously is in user comparison of the cost of riding on a railroad and the cost to him of driving in his personal automobile. The railroad owns its vehicles and its exclusive right of way, its terminals and storage yards. The auto driver owns his car, but drives over, and loads and unloads on, public streets. He parks on valuable city land if he can find available unrestricted space. As a result, public land in most city streets has been given over during business hours to private car storage and "terminals" to the extent of 25% to 50% of capacity. The railroad, once a "vicious monopoly," still carries the burden of heavy real estate and other taxes. The motorist, in contrast, pays nominal license and fuel taxes which fall short of the government outlays for his benefit and control. He also pays tolls on a few new facilities and for a small percentage of his parking. There are, then, definite differences in cost to the community of rail and motor trips which are not taken into consideration in user decisions.

Another major difference in cost determinations between travel by auto and by all other methods of public transportation arises from the economics of fixed charges. The owner of a vehicle must, of course, carry the burden of depreciation, insurance and operating costs. Of these costs, only the operating costs rise or fall with the per trip use of the vehicle; most of the other costs run on regardless of use. This law applies to all owners, be they owners of railroads, buses, taxis, or private cars. When a railroad or bus company fixes its fares, it must apportion a part of the depreciation and insurance costs to each trip. When the user computes the cost of travel to work by public transportation, therefore, he is dealing with a price which includes a portion of fixed costs. When he computes the cost of traveling to work in his privately owned car, however, he excludes depreciation and insurance, and includes only fuel and oil, and perhaps tolls and parking costs. The automobile is a multi-purpose mode of travel for most owners, used for recreational purposes and family errands as well as for commuting purposes. The fixed costs of maintaining the automobile are therefore considered as general overhead and are

not allocated on a per trip basis. Of course, most private owners keep no accounts, nor do they engage in the type of economic analysis just sketched. They merely compute the cost of their trip on the basis of operating expenses only because "the car is just sitting there anyway." Thus, the practical man and the theorist come out at the same place.

From the foregoing analysis, it follows that the decisions made by individuals as to modes of travel, trip by trip, though thoroughly rational and economical for them at the time, are made with a grossly distorted picture of the true costs, particularly with reference to fixed costs and costs to the public. These happen to comprise a major part of the total true cost and involve private use of community resources, a matter of overriding public concern.

Charges to the user for specific transportation services are becoming more and more significant to the economics of trip decision, especially in and around the eastern urban areas and in the Middle West. Such charges are generally applied only to new facilities, and are politically justified by the greatly improved service rendered by a new bridge, tunnel, thruway, or garage. Some of these facilities run a profit from the start, while others operate in the red for many years. Without these charges many of the most spectacular motor transport improvements could not have been undertaken because of the lack of state and local financial resources, inadequate borrowing powers and unwillingness to build.

Lyle C. Fitch, former New York City Administrator, has called attention to another economic effect of such user charges. When a price is attached to the individual trip, it will of itself exclude from the facility those who feel that the service is not worth the cost to them for the trip in question. Hence the user is automatically persuaded not to use a public facility unless there is an economic justification for doing so. If a service is not thus rationed on an economic basis, it will be automatically rationed by "queuing" and congestion which favors the person whose time is least valuable to himself, and presumably, to the economy.

It has also been pointed out that this resort to the market has a political benefit. When tolls are charged, those who use the facility are "voting with their dimes and quarters," thus expressing their continuing need for the service. This is surely a more accurate way of determining the required levels of service than holding public hearings and asking for legislative votes. The automatic economic rationing is also more acceptable to the public than any method of sorting out and restricting the frivolous users by administrative devices, as done during the war. In peacetime, it is doubtful that the public would readily accept such administrative rationing. In contrast, no one resists the economic rationing, except when it is applied to a service long free or underpriced.

It must be noted, however, that pricing a service does not decide in advance the needs for the service. The advance decision must always be a political decision, however much it is based on prior engineering and fiscal analysis. But the psychology of measuring the need for a service, the effective benefit of it, over against the charges to be paid for it has its own economic value.

In view of these compelling facts concerning user decisions one must conclude that the transportation and circulation system of an urban area cannot be determined or designed by the market or by the user, or by a simple ex-

tension of O & D studies. The user will always pick and choose to suit his own preferences and economic need, but the framework of choices given him must be set up by public action.

The third theater of decision, crucial to the transportation system in any urban area, involves government allocation of land for transportation purposes, the determination of what proportion of the total land area shall be dedicated to circulation. This decision encompasses the laying out of streets and highways; location of garages, parking areas and terminals; and approval of mass transportation franchises or routes. This aspect of city design is similar to the problem of theater design. In the theater, the revenue is derived from the seats. The more space given over to seats and the less to aisles, the higher the revenue. Community income also arises from the "seats," that is, the land put to economic use. If half the land or more is given over to the transportation and circulation system, the economic life of the community will register the effect. The proper balance must be found between seats and aisles. If the workers in modern office buildings all went to work in their private cars, not less than 75% of the total downtown land area would be required for the thruways and streets, and for each office building the size of the Empire State Building two garages of equal size would be required to store their cars. Some cities will choose a predominantly private auto circulation system, and will have an economic community in which business and professional life are atomized by space consuming gaps of land dedicated to transportation. This alternative has many attractive features, but for cities with important executive, managerial, financial and professional segments in a pattern of multiple idea exchanging and interdependent "little economies," a different type of urban concentration is required. In such cities no large space separators can be permitted; land must be conserved and arranged for the maximum face to face contacts.

Land allocation decisions are made by local government with an assist from state and federal agencies with respect to the through highways. Local governmental decisions are not now made as part of a general plan, but only as each separate facility is designed and constructed by each local governmental unit, be it city, county, "authority," or town. As a result, there is no clear picture of the direction in which the total system is moving. Until recently the only overall circulation plan in New York City was that drawn up 35 yr ago by a group of private citizens. A half dozen separate official agencies have built particular subway extensions, bridges, tunnels, thruways, ferry systems or garages. One department regulates parking lots; another installs parking meters and decrees one-way streets. And no one worried about the commuter railroads until they began to disintegrate.

Urban land is too valuable to the community to be squandered away thoughtlessly, piece by piece. No land should be allocated in any city to any part of the circulation and transportation system, public or private, without competent impartial professional examination; without review in terms of the purposes and aims of the city; or without a cross check with an official comprehensive circulation plan or program. The job of building urban transportation for the future is not something that can be done by isolated efforts, by squabbling authorities, not by private agencies however competent. It is a job for a responsible and well staffed instrument of state and local government. And it must be done on a comprehensive basis in terms of the broad goals of the region.

The fourth theater of decision affecting the circulation and transportation system of an urban area involves controls of land uses outside the trans-

portation system. It encompasses the determinations of local municipal governments in adopting the city map, defining zoning controls, approving the platting of private land, and locating public open spaces and facilities. These are city planning and legislative acts generally undertaken under executive and technical guidance. These are also problems of urban design, similar to the design problems of a factory or office building. The problem of city land use planning cannot be approached in precisely the same way as that of office design, however, for the American city is not a completely controlled social and economic structure, nor should it be. Under the definition of a city as a place for free and easy, unregimented contacts, the city cannot be a structure rigorously controlled by a fixed architectural blueprint. Plans and designs for a city must not reach beyond the elements of the framework lest they intrude upon the free flow of human contacts. But to preserve this very freedom, it is necessary to apply the same kind of social limitation to urban land use as is applied to other spheres of human conduct in order to maximize the free opportunities of all by limiting the unsocial acts of the few. Through its proportionate effect on the total circulation system, private land use in an urban area affects not only the immediate neighbors, but also the whole area.

Each urban land use, according to its kind and intensity, tends to generate a known kind and amount of traffic. Hence, the pattern of a city has great influence on the economy of its internal transportation system. Imagine a city of 2,000,000 people arranged lengthwise on an oblong island as follows: first, an industrial section with factories; then the area of offices and stores; next low rent housing; and finally high rent housing. Compare this to a city arranged thus: factories; low rent housing; business; and finally high rent housing. Merely by the interchanging of the two use districts in the second pattern, cumulative transportation costs might be cut by 25% to 30%. Between the least economical and the most economical arrangements of these four traffic-generating sections, there is a mathematical difference of 67.2% in man-miles of commuter travel. While this is an imaginary model, more clear-cut than reality ever is, variations of this problem exist in every city. Washington, D. C. recently found that it was laying out a new transit system on the assumption that many people would live in the northwest of town and work in the southeast, commuting at peak hours through the heart of the business center; and Baltimore found that a proposed industrial district would permanently involve unnecessarily high transportation costs. When uneconomic costs of this sort are deliberately built into a community, they cannot fail to have a permanent effect on its total economy.

Any city which is determined to solve its traffic problem in the next generation can do so by concurrently regulating its land use pattern and designing its major comprehensive transportation system to produce a reasonable balance the two. The balanced system must have a series of economic persuaders and controls built into it, and must be continually under planned modification to meet changing conditions. This solution cannot be achieved all at once, but it can evolve once a community firmly and irrevocably decides to work its way out of its present chaos. Such decision must be based on a firm commitment by the business, banking, labor, civic, educational, entertainment and political leaders of the community. The lasting solution cannot be brought about by a few well intentioned people working in stealth, but only by broad community consensus and sustained administration.

There are at present many obstacles to such community action which cannot be explored here. The fundamental problem is, however, the fragmentation

of the metropolitan area into scores or hundreds of local governmental authorities. As a result, there is frequently no concept of land use allocation or zoning control in the fastest growing fringe of the urban area. Each independent unit seeks to attract high revenue producing development or to preserve its particular character with no thought to the balance between land uses and the circulation system of the entire social and economic area of which the given town is an inseparable part. The ultimate penalty for this type of thoughtless and selfish development will be very high for both the individual towns and the entire urban region.

It is clear that decisions in all four theaters affecting urban transportation must be based upon intensive application of research and development to keep abreast of technological progress potentials. This is true of all decisions involving extensive capital investment and complex management, scheduling, and controls. Some links in the complex transportation chain have been subject to extensive research, while others have been neglected in this respect. Billions of dollars in tax revenue have been poured into the development of faster and more powerful airplanes in the interest of national defense, although developments in the interest of the airlines and the customers have not been fast in coming. In contrast, the railroads have been all but barred from comparable research and experimentation through the restraining hand of government control as well as through their own unimaginative and short-run fiscal policies. The automobile, a now completely dependable, if inefficient, instrument has been improved under the pressure of sales competition, while the total highway system, particularly that part within urban complexes, has shown little improvement from technology, research, or development. Even the highway and street connections to the airfields have been overlooked as part of the air transportation problem.

The only effective way to provide for research and development concerning the total transportation system rather than that related to a single segment is through general public support. Private interests cannot undertake the task for several reasons: it is costly and not immediately translatable into profits for any one enterprise; the decisions based on such research must be governmental; the benefit from it is primarily public. Yet there is evidence that a small amount of governmental stimulation and encouragement would produce a considerable number of exciting technical developments such as electronic controls, new techniques of suspension and power application, composite operating arrangements, and other developments which might provide faster movement, greater passenger comfort and safety, and the economies of more extensive automation. It is system research, not vehicle research, which is required to open up the truly dramatic possibilities of the future.

#### OTHER ECONOMIC CONSIDERATIONS

There is no thought of covering all of the economic considerations affecting transportation in this brief paper. There are many economies and diseconomies of scale involved in every decision related to urban transportation, although present knowledge of these factors is fragmentary and most decisions are made without the benefit of rational analysis. Perhaps such decisions can be regarded as experimental and thus subject to revision after trial. While this approach is not fundamentally unscientific, it is particularly wasteful when the

experiment is irreversible for generations to come as with the establishment of the circulation system.

One matter for analysis in transportation decisions is the effect of the circulation system on land values throughout the metropolitan area. Robert Murray Haig demonstrated over a generation ago that a perfect, "frictionless" urban transportation system would equalize site values throughout the particular area, making land in the center no more desirable or income-producing than land in the farthest suburbs. The equalizing effect of improvements in the circulation system is dramatically evident in the current centrifugal spread of residential, retail, and service trade site values into the country. But, with respect to the highest quality commodities and services, and to the higher managerial levels where creative idea exchanging requires face to face contacts, there is a demand for aggregation *per se*, which is the fundamental reason for the formation of the urban center as has been pointed out. In this respect, the best possible circulation system will facilitate confluence from a wide base, creating higher peak land values at the center. In New York City, one can see the centrifugal and the centripetal forces operating simultaneously. The functions which gain by flying out and those which gain by pressing in, and their interrelationships in the metropolitan complex, are still inadequately understood.

A further basic economic and political problem of the urban area relevant to transportation design is posed by the development of insulated and favored suburban enclaves. "Quality" suburbs which have higher incomes, higher revenue producing industry, and therefore more tax resources per child in school, stand in contrast to the neighboring suburbs which carry the burdens of development without sufficient resources. Meanwhile, the central city is challenged with the problems of renewal at the time when many of its taxable values are sliding away. The economist recognizes in this situation the basic question of redistribution of income, both within the public and private sectors and between the two. The disparities, however, are political as well as economic in significance and will result in fundamental changes in present tax systems and in the structure and powers of local political units. While the major adjustments will stem from national social philosophy and politics, local governments as the major retail outlets in the system of social income distribution must be concerned with the problem of redistribution. It is a problem which affects and is affected by metropolitan area transportation developments and decisions.

## CONCLUSIONS

The conclusions emerging from this paper should be borne in mind by all who are interested in the economics of urban transportation.

First, it is clear that each single major traffic, transportation, or terminal problem of the city must be approached comprehensively as an integral part of the total circulation system and philosophy, even though this approach may require additional studies, co-operation, and delay. Disaster will result from control by "monomaniacs," be they enthusiasts of rail, rubber, monorail, helicopter, or conveyor belt.

Second, no large city today can plan, design or finance its internal circulation system without incorporating into these processes consideration of the

broader metropolitan area of which it is a part. The geographic area considered in dealing with internal transportation must be greatly extended beyond the city lines which were established when the streetcar and horse drawn vehicle dominated the scene. The extension must be political as well as technological, encompassing broader jurisdictions with structural co-operation of federal, state and local authorities. Such is the requirement of the patterns of life and work which the American people have chosen and of their individual, flexible units of fast locomotion.

Third, quite different answers must be anticipated to the traffic and transportation problem in each of the major urban areas depending upon the shape, functions, history and future mission of each area. Cities cannot radically alter their basic place in the nation, but they can fail to meet the competition of other areas by failing to meet their particular internal circulation needs. Transportation may be the critical determinant of a city's future arrangement, efficiency and livability. It therefore becomes essential to develop comprehensive planning on the basis of solid understanding of the community and its commitments. Land uses and rights of way, modes of movement and communication, all must be dealt with from the perspective of a recognition of the evolving social and economic structure in which human needs are paramount.

Fourth, circulation must be rendered easy and inexpensive by creation of complementary transportation system and land use pattern which eliminate unnecessary cross hauls and long linkages and induce for each movement a mode which is appropriate and economical. Excessive consumption of time, manpower, and material in the processes of circulation becomes a serious drain on the income of any community and thus injures its competitive economic situation in the world.

Fifth, while the selection of the best mode of urban movement for each trip must be left up to the individual user, it is imperative that the community determine and provide the general outlines of a rational comprehensive circulation system. As a practical matter, the user can select only from the available modes. Without advance community decision on the system as a whole, the free decisions of individuals produce inordinately expensive chaos. With such advance decision and concurrent control of density and land uses, the community can rely upon the marketplace rather than upon administrative and police controls to achieve an efficient, economical and flowing total system.

Sixth, a method of public encouragement of and support for general transportation research and development must be found. The public has much to gain from such a program which focuses upon the composite system as well as the individual segments. Private enterprise can undertake profitably only a very small part of the task which is required.

Finally, it is clear that any new or modified circulation and transportation system will function effectively for the future only as the load on that system is held in reasonable balance by land use control.



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PLANNING AND ENGINEERING CONSIDERATIONS FOR THE OFFICIAL MAP

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SYNOPSIS

This paper deals with two distinct yet closely interrelated problems. The first of these problems is that of how to make the official map of the city a truly useful and effective plan implementation device. It is a problem to which planners have generally given little attention. Consequently, a potentially powerful planning tool has been either ineffectively applied, or entirely neglected.

The second of these problems, closely related to the first, is that of economically providing an adequate system of horizontal control in urban areas. Such a system can serve as both the basis for the compilation of accurate maps and the execution of all necessary survey work. Because of the great amount of mapping being undertaken in urban areas, particularly by aerial survey methods, this problem should be of great concern.

This paper attempts to set forth the basic relationship between these two problems, and proposes a simple and economical system of control. The system will not only make the official map an accurate and effective plan implementation device, but it will make urban maps compiled by photogrammetric methods far more useful for planning and engineering work, and will expedite

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the conduct of planning, engineering, and cadastral surveys, both public and private, throughout an urban area.

### INTRODUCTION

The nation's population is undergoing (in the 1960's) an unprecedented growth and urbanization. The widely dispersed characteristic of this urbanization, with its accompanying dependence on motor vehicle transportation, has created severe pressures to extend urban street systems and to widen, realign and reconstruct existing trafficways. The largely unplanned characteristic of this urbanization has created similar pressures on park and open space facilities. Adequate solutions to these transportation and open space problems will not only depend upon sound plan formulation at all levels of government, but also on practical plan implementation.

An interval must exist between the time a given project is incorporated into a comprehensive plan and the time of actual project construction. This time lag is inherent in the planning process, and it is during this time lag that means must be found to most effectively reserve land for the project as well as to insure the integrity of the plan.

TABLE 1

Cities (Type)	Cities with Official Maps		Cities with Zoning Ord.	
	Number	Percentage	Number	Percentage
1st Class (Milwaukee)	0	0	1	100
2nd Class (39,000-150,000)	5	62	8	100
3rd Class (10,000-39,000)	15	68	22	100
4th Class (under 10,000)	23	17	75	56
Villages	20	6	60	17
Total	73	14	157	30

The official map is one of the oldest plan implementation devices at the disposal of the city planner. It is also probably the most effective and efficient, though not the only, device which can be brought to bear on the problem of reserving land for future public use. Yet it is probably the least understood and least used of all plan implementation devices. Zoning ordinances, subdivision regulations, building and housing codes, and urban renewal measures are all more familiar, better understood and more effectively applied by city planners.

As an example, in Wisconsin as of January 1960, the number of municipalities having official maps versus the number of municipalities having zoning ordinances is shown in Table 1. The reluctance of planners to use the official map probably stems from one difficulty; namely, the problem of locating and mapping each existing and proposed street and public open area with the necessary accuracy and precision. While this is an engineering problem of consider-

able magnitude, particularly in larger cities, it is by no means insurmountable, and this paper will attempt to set forth a practical technique for its solution.

### SCOPE

While the concept and actual use of the official map in the United States dates back to 1806, the prototype of all modern official map acts was adopted by the state of New York in 1926. Subsequently, Maryland, Michigan, Minnesota, New Hampshire, Utah, and Wisconsin have enacted enabling legislation based to a considerable extent on the New York act. At least eight other states have their own forms of official map acts. Although this paper is primarily concerned with practice and experience under Wisconsin legislation, the basic postulates and application techniques which it attempts to set forth should have universal application.

### PLANNING CONSIDERATIONS

*Introduction and Definition.*—Section 62.23(6) of the Wisconsin Statutes provides that the common council of any city may establish an official map for precise designation of right-of-way lines and site boundaries of streets and public properties. Such a map has all the force of law and is deemed to be final and conclusive as to the location and width of both existing and proposed streets, highways and parkways, and the location and extent of existing and proposed parks and playgrounds. The statutes further provide that the official map may be extended to include areas beyond the corporate limits lines but within the extraterritorial plat approval jurisdiction of the municipality. (In Wisconsin, extraterritorial plat approval jurisdiction includes the unincorporated area within 3 miles of the corporate limits of a first, second or third class city, and within  $1\frac{1}{2}$  miles of a fourth class city or a village.) It is interesting to note that in Wisconsin the official map act is a subsection of the basic planning enabling act, Section 62.23, entitled "City Planning," and as such is made applicable to villages, towns, and counties, as well as to cities.

*Function and Benefits.*—The primary function of the official map is to implement the community's master plan of highways in a manner similar to that in which the zoning ordinance and map should implement the community's land use plan. The official map permits the community to protect the beds of future streets, as well as the beds of partially or wholly developed streets which are to be widened, by essentially, prohibiting the construction of new buildings in such beds. The possible monetary savings which can accrue to the community from such protection of street rights-of-way are enormous, but the fact that an official map assures the integrity of the community's master plan of highways is even more important.

A secondary function of the Official Map is to implement the community's master plan of parks and open spaces. In this respect it can be used to protect unusual natural features such as scenic and historic spots, water courses and drainageways, and flood plains and marshes. Inclusion of such features as proposed park land on the official map gives strong legal status to planned projects and freezes the use of the land within the indicated taking lines. Again, possible monetary savings which can accrue from such reservation for

future use are high, and the protection offered the public health, safety, and welfare in connection with floodplains and marshes is certainly important.

An incidental, but important, benefit accruing to the community through properly executed official mapping is that such mapping adequately locates and records all existing street lines that constitute the boundaries of the public's property and thereby tends to stabilize the location of real property boundaries, both private and public. As an accurate existing conditions base map, the official map greatly expedites planning and engineering work. City planning often involves the legal establishment of lines bounding districts reserved for specific purposes, and formulation and implementation of physical plans requires detailed knowledge of the location of existing street lines and boundaries of real property. The official map can provide this information most effectively and efficiently.

*Relation to the Master Plan.*—The official map allows the municipality to express its intent to reserve land for public purposes without commitment to actual acquisition. Thus, the official map functions as a refinement of the community's master plan, reflecting certain of its aspects in a precise, accurate and legally binding manner.

Upon completion of the precise base mapping, specific projects (new major streets and highways, proposed street widenings, relocations or vacations, proposed parks, parkways, or drainageways), may be taken from the master plan, detailed as to specific location, and placed on the official map. Under the Wisconsin statutes, adoption of the precise base maps themselves requires common council action, while subsequent additions or changes require duly held public hearings before such action, as well as referral to the plan commission for report and recommendation.

Thus, by exercise of the police power, specific proposals contained in the master plan may be implemented. Street and open area reservations can be based, not on immediate needs alone, as must be the case when such areas are acquired by exercise of the power of eminent domain, but on long-term future needs as well.

In addition to assuring that land needed for future streets and open spaces will be available at the price of unimproved land, the adoption of an official map under the Wisconsin statutes has certain other consequences which tend to give direction and pattern to future community development. Section 62.23 (6)g provides that, where an official map has been established, no public sewer or other municipal street utility or improvement may be constructed in any street until such street is duly placed on the official map. Similarly, no permit for the erection of any building may be issued under this subsection unless a street giving access to such proposed building has been placed on the official map. Both of these provisions are particularly valuable in controlling development in the outlying rural-urban fringe area, assuring that such development occurs in conformance with a logical, integrated plan. It is also interesting to note that Section 236.13(b) of the Wisconsin statutes provides that the city may, as a condition for placing any existing private street or way on the official map, require its improvement to municipal standards.

Although the official map is usually applied only to proposed major streets, parks and parkways, a strong case can be made for its application, in undeveloped or partially developed areas, to proposed minor streets and playgrounds as well. If planning and engineering staffs permit the careful prepara-

tion of detailed neighborhood development plans—and intelligent plat review by planning bodies is all but impossible without such plans—the minor streets, combination neighborhood park and school sites, and drainageways shown on such plans should be finalized and placed on the official map. Such mapping will overcome special problems of disjointed land ownership patterns and assure the development of integrated neighborhood units in a manner not possible through subdivision control alone.

*Enforcement.*—Under the Wisconsin legislation, the police power device used to enforce the official map is the building permit. Section 62.23(6)(d) provides that no permit shall be issued for any building in the bed of any street highway, or parkway shown on the official map except as provided by certain exceptions. The exceptions provide for appeal in cases in which the land within the mapped street, highway or parkway is not yielding a fair return to the owner. In such cases, the zoning board of appeals may grant a building permit which will as little as practicable increase the cost of opening such street, highway or parkway, or tend to cause a change of the map itself. It should be noted that Section 62.23(6)(b) specifically states that the placing of any street, highway, parkway, park, or playground on the map shall not in itself constitute the taking of land for such purposes nor be deemed to constitute the opening or establishment of the public facility in question.

A certain practical and desirable degree of flexibility is given to the map by Section 62.23(6)(c) which provides that changes or additions to the official map made by duly processed and approved subdivision plats shall not require the public hearings or special common council action normally required for such changes or additions, provided, however, that the changes or additions do not affect any land outside the platted area in which the change is being proposed.

## ENGINEERING CONSIDERATIONS

*Introduction.*—It has been noted that the master plan is a general plan, certain parts of which are often presented by non-precise maps, whereas the official map, to properly reflect and refine certain aspects of the master plan, must be capable of precise and accurate interpretation. This requirement for precision and accuracy seems to provide the principal difficulty in the proper application of this plan implementation device. Apparently many city planners, although aware of this problem, have been puzzled by its true nature and have not, therefore, been able to propose adequate solutions to it. J. H. Beuscher and J. C. Kucirek, though recognizing the existence of this difficulty in their study of the official map,<sup>2</sup> have demonstrated the usual failings of city planners with respect to this problem by suggesting that it might be overcome by specifying minimum scale, standards of "preciseness," and "contour information" in the state enabling legislation.

*Basic Concepts.*—In order to place the problem in its proper perspective, it is necessary to understand certain basic and simple surveying and mapping concepts. First, it must be understood that both accuracy and precision are required in an official map, and that these two terms are not synonymous.

<sup>2</sup> "Wisconsin's Official Map Law," by J. C. Kucirek and J. H. Beuscher, *Wisconsin Law Review*, 1957, p. 176.

Precision is defined as refinement in the performance of an operation or in the statement of a result, and it connotes apparent nearness to truth. If it is desired, for example, that all scaled distances on an official map should have a precision of plus or minus 5 ft, and if it is expected that the map draftsman is to work to a tolerance of  $1/40$  in., then the required scale of the map must be 1 in. equals 200 ft. Moreover, by simply showing supplementary dimension figures on the map any desired degree of precision can be obtained right down to the nearest  $1/100$  ft.

Accuracy, however, is defined as degree of conformance with a standard, and it connotes absolute nearness to truth. In a map this means true scale representation of conditions on the ground as they actually exist. (A common method of specifying accuracy is to require that 90% of all well-defined features shall be plotted to within  $1/40$  in. of their true coordinate positions, and that no point shall be more than  $1/20$  in. from its true position.) It should be noted that, whereas precision is related to scale—or to number of places behind the decimal point of expressed dimensions on the face of the map—accuracy is independent of scale and dependent solely on the methods used to compile the map. Thus, a map may be accurate without being precise and vice versa. Unfortunately too many existing official maps lack both the necessary precision and accuracy.

Any accurate mapping project requires the establishment of a system of horizontal control. This control consists of a framework of points whose horizontal positions and interrelationships have been accurately established by field surveys. The map details are adjusted to these points and may be checked against them. An effective official map further requires that this control net be permanently monumented on the ground, so that ownership and reservation lines on the map may be accurately re-established in the field when a planned project reaches the construction stage. That is, the official map must not only accurately reflect field conditions, but must be accurately reproducible on the ground.

In this connection it should be noted that real property boundaries are dependent for their location on monuments erected in the field, and that the certainty of their location may be destroyed by the destruction of these monuments. Since the accurate location of boundary lines is essential to sound official mapping, all basic land survey monuments in an urban area should be so related to each other and to the horizontal control net established for the mapping that they can be not only accurately mapped, but accurately reestablished as well.

The degree of precision to be selected for a given official map should be related to the characteristics of the community being mapped. For example, for a new and rapidly developing exclusively residential, country estate village, with large minimum lot areas and large open yard requirements, a scaled precision of  $\pm 10$  ft might be reasonably adequate, requiring an official map at a scale of 1 in. equals 400 ft. A relatively older, more densely developed, industrial community might, on the other hand, require a scaled precision of  $\pm 2$  ft, requiring a map scale of 1 in. equals 80 ft. In each case the degree of accuracy built into the maps must be consistent with the desired degree of precision, and mapping procedures must be modified accordingly.

*Suggested System of Control.*—If adequate base maps of sufficient precision exist, and if these maps are based on permanently monumented field surveys so that their accuracy can be ascertained, then an official map can be readily

created by simple compilation techniques. If, however, as is more often the case, adequate base maps are lacking, then an official mapping project will first require the construction of base maps of sufficient precision and accuracy.

As previously noted, any such accurate mapping project requires the establishment of a system of horizontal control. If established in accordance with the best engineering practice, such horizontal control would be established by first order triangulation or traverse nets tied to the national survey control net. This primary control would in turn be supplemented by second order traverse nets, which would tie in all street boundary line points, thereby permanently establishing their coordinates as well as the bearings and distances of all street boundary lines. Although the value of such a broad city survey may be obvious to the engineer or city planner, because of the survey's high cost it is often difficult, if not impossible, to convince lay authorities not sufficiently informed of its benefits. Moreover, such a broad city survey may well be out of the financial reach of many smaller municipalities; thus, delay or indefinite postponement of the creation of an official map for such communities will result.

A modified system of horizontal control based on the U. S. Public Land Survey System is therefore suggested as a practical alternate basis for the compilation of an official map. The establishment of such a control system would require the relocation and monumentation of all section and quarter section corners within the area to be mapped, and the use of these corners as stations in a second order traverse net. The traverse net would determine the length and bearings of all quarter section lines, as well as the geographic position of the corners themselves. Although such a system of control has some theoretical disadvantages, it has the following important advantages:

1. It permits the ready compilation of property line base maps on a quarter-section basis, to standards of precision and accuracy sufficient for official mapping, with an absolute minimum of ground control survey work. Because the boundaries of the original government land subdivision form the basis for all subsequent property divisions and boundaries, the accurate re-establishment of the quarter section lines permits property boundary base maps to be compiled, within the required limits of accuracy and precision, by simply reconstructing on the drawing board all old plats and deed descriptions within the limits of each quarter section.

Satisfactory base maps of all but the oldest and most intensely developed parts of the larger cities can be compiled in this manner, utilizing only the absolutely minimum horizontal control system outlined. In the oldest parts of the larger cities, it may be necessary to supplement this minimum control by field surveys which would locate and monument individual block corners. This would be necessary only to reconcile gross discrepancies between recorded plats and existing occupancy in densely developed areas such as the central business district.

2. It permits the public land survey corners to be readily tied to the state plane coordinate system, thereby making it at once possible to prevent the future loss of these corners and to coordinate details supplied by aerial mapping to the real property boundaries. This placing of property boundaries and topographic data on the same control datum is essential to proper official mapping, and, indeed, to sound engineering practice, yet such a common control datum is rarely used.

Much city mapping work is done by aerial survey methods, yet usual aerial mapping practices do not provide accurate boundary line information on photogrammetrically compiled topographic maps, thus seriously impairing their usefulness for planning and municipal engineering work. The establishment of state plane coordinates for the public land survey corners would permit the transfer of details supplied by aerial mapping, including hypsometry, to the official map by comparatively simple overlay methods.

3. The control net would be extremely practical as it would be readily usable by both private and public surveyors and engineers for all subsequent survey work without a change in their methods of operation. This permits the coordination of all survey work within the urban area.

4. Property line and official mapping can be readily and economically extended into newly developing areas, since all new plats must, by statute, be tied to corners established in the U. S. Public Land Survey, and since the accuracy of these new plats can be readily controlled by land subdivision regulations. All new land surveys would be "automatically" tied to the state plane coordinate system without any particular effort or expense on the part of the local land surveyors or a change in their methods of operation.

5. Such a control system would be readily adaptable to the latest survey techniques, and of relatively low cost as compared to a first order triangulation system with its attendant supplementary control net.

*Technical Procedure.*—If the suggested modified method of control is used, the actual field survey work may be divided into two operations.

1. Locating or relocating on the ground all section and quarter section corners and permanently monumenting all such corners throughout the area to be mapped.

2. Executing the control survey measurements, computations and adjustments necessary for the mapping work.

The Bureau of Land Management (formerly the U. S. Public Land Office) defines public land survey corners as existing and therefore recoverable, obliterated, or lost, and prescribes procedures for the restoration of obliterated and lost corners. In most of the major urban areas in Wisconsin, almost all the public land survey corners are obliterated corners, and must be relocated accordingly. All work in this respect must be based on the assembly of all authoritative information available, such as title documents, road records, subdivision plats, private and public survey records and existing monumentation and occupation, as well as on proper analysis of this information to arrive at the best possible determination of the actual location. Proper performance in this regard depends largely on a knowledge of local survey custom, condition, and the laws on boundaries and titles in the particular jurisdiction within which the work is being done. The importance of this locational work cannot be over-emphasized, for the corners located in the official map survey will have genuine authority that will grow with the passing of time. This phase of the work should, therefore, either be done by the city engineer or sublet to a competent and qualified local land surveyor.

After relocation and permanent monumentation of all the section and quarter section corners throughout the area to be mapped, control traverses must be run, using the monumented corners as stations, to determine the geographic coordinates of those corners and the lengths and bearings of all the quarter-

section lines. All coordinates should be based upon the state plane coordinate system, and sufficient survey connections must be made to basic United States Coast and Geodetic Survey, Dept. of Commerce, (USCGS) control stations of the national net to permit the proper checks and adjustments in both the traverse lengths and bearings and in the coordinate values of the monumented public land survey corners. Other survey methods, such as triangulation or trilateration may be substituted, at least in part, for the traverses where it is feasible and economical to do so.

The horizontal control surveys should be essentially of second accuracy, even though the scale selected for the official map may not require this degree of accuracy for the mapping work itself. The higher degree of accuracy is essential if the control net is to have its maximum utility in subsequent local survey work.

The control traverse, and accompanying computation and adjustment, is probably best done by photogrammetric engineers having well-trained control survey crews on their staffs. These firms have the latest survey equipment at their disposal, including optically reading theodolites and electronic distances measuring devices. The latter are particularly adaptable to the work outlined, permitting very high standards of accuracy to be obtained at relatively low cost.

A particularly efficient and economical arrangement is for a municipality to undertake an aerial topographic mapping project as an integral part of the official mapping program. This not only supplies the topographic data necessary to the proper design of projects to be placed on the official map, but affords a substantial economy in the control survey work. Control surveys may account for as much as 1/3 of the cost of an ordinary aerial topographic mapping program. When it is realized that much of this control is unmonumented and unrecoverable, and almost all of it unusable by the local surveyor, the real economy of requiring the aerial maps and land survey system to be placed on a common permanently monumented datum becomes apparent.

On completion of the control surveys, actual compilation of base maps for the official map can begin. Depending on the scale selected for the official map, the base maps are best compiled by quarter-section or section. For all but the smallest communities an individual sheet should be used for each quarter-section or section. Section and quarter-section corners should be plotted by coordinates and all other property lines should be plotted by scale from title records and adjusted to the quarter-section lines. The base maps should show the following minimum information:

(a) The grid bearings and distances of all quarter-section lines, the monuments which mark all section and quarter-section corners together with their state plane coordinates.

(b) All street lines, alley lines, and boundaries of all public property; plat or record dimensions of all street widths at intersections and at all changes in width; and all platted lot dimensions. In unplatted areas real property boundaries may be shown by scale only based on title records.

(c) Structures, including public, industrial and important commercial buildings, private dwellings in undeveloped areas, all railroads, and all bridges, and the shore lines of lakes and principal streams.

(d) In undeveloped areas, contours at an appropriate contour interval, which should not be more than 5 ft, and

(e) Necessary title, legend, names of streets, parks, subdivision plats, stream and lakes.

Compilation of base maps in accordance with the specified procedure will permit reduction on, for example, a 10 to 1 ratio, and such reductions will be used in the compilation by mosaic process of a wall map. On completion of the base and wall maps, and their adoption by the local governing body as an official map, specific projects can be detailed and placed on the map as plan implementation begins.

### CONCLUSIONS

An official map, adopted in accordance with Section 62.23 of the Wisconsin Statutes, fulfills an important planning function, providing an effective means of implementing both the community's master plan of highways and master plan of parks and open spaces. The monetary savings which can accrue to a community through such implementation in connection with major street and highway projects and park and drainageway reservations are large indeed. The fact that the official map insures the integrity of the community's street and park plans and provides for an integrated and coordinated development of these facilities is, however, even more important.

Although other devices, such as building setback requirements in zoning ordinances (actually an improper use of the front yard requirement), special building setback ordinances *per se* along major streets, building setbacks lines on plats, and private deed restrictions can all be used to reserve land for future widening of existing streets, none of these devices can be applied to proposed future streets and highways. Subdivision control ordinances can, it is true, be used to protect future streets,<sup>3</sup> but they can do so only indirectly, and cannot be used to prevent the erection of buildings in the beds of future streets, which may take place without subdivision. The official map is the only plan implementation device that can effectively assure the integrated development of the community's master plan of highways.

An official mapping program should be based on adequate base maps of the required precision and accuracy compiled on a framework of permanently monumented horizontal control. This framework of control can be most effectively and practically created in such states as Wisconsin by use of the U. S. Public Land Survey system as outlined previously.

It has been pointed out<sup>4</sup> that in the conduct of a city's business two factors require constant consideration: the land itself with its configuration and physical characteristics, and the boundaries of real property. The need for full information concerning these two factors is apparent, and they cannot be ignored in any city planning work. The base maps for an official mapping program, if compiled as outlined herein by a combination of ground and aerial survey methods, can provide the necessary inventory of the physical facts relating to

3 "Protecting Future Streets; Official Maps, Setbacks and Such," Amer. Soc. of Planning Officials' Information, Report No. 119, February, 1959.

4 "Technical Procedures for City Surveys," Manual of Engineering Practice No. 10, ASCE, 1957.

the land and its ownership, and can thus be of great value in operating existing facilities as well as in planning and engineering extensions to them.

The monumented control as outlined herein would expedite public surveys of the type made almost daily, year after year, by the city engineering and water departments, county and state highway departments, and such ad hoc agencies as metropolitan sewerage, expressway, and airport and harbor commissions for the planning, design and construction layout of all types of public works projects. Such control would particularly expedite the precise location and mapping of underground structures and utilities, both public and private, and is in this manner useful to power, gas and telephone companies as well as to the sewer and water departments of governmental units.

Such monumented control would, moreover, stabilize real property boundaries, both public and private, and would be of great value to private land surveyors. Property corners in most of Wisconsin's urban areas are inadequately monumented (as of 1961) and, therefore, susceptible to loss. Points of beginning for legal descriptions often depend on unmonumented corners or on street intersections that cannot be precisely relocated, so that the accurate retracement of property boundaries is difficult and expensive while the accurate mapping of property boundaries by public agencies is nearly impossible. The present practices will become more and more troublesome as urbanization intensifies and land values increase, and will result in increased litigation and continued uncertainty of title. Establishment of an adequate horizontal control system, as outlined herein, will eliminate many of these difficulties and prepare the way for the ultimate use of state plane coordinates in boundary descriptions.

Thus it may be seen that a properly constructed official map represents not only a particularly effective plan implementation tool, but a means of collecting, coordinating and presenting, in permanent and useful form, much valuable information essential to sound planning and engineering practice. As such, the official map represents a sound permanent capital investment by the community in its future.



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LAND USE AND EXPRESSWAYS<sup>a</sup>

By Fred W. Tuemmler, M., ASCE<sup>1</sup>

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SYNOPSIS

The major aspects of the land use-highway relationship are stated, and several methods of bringing it into balance, are suggested.

Lines of transportation inevitably determine patterns of land use, so that whoever plans the location of expressways to a large extent, commits the future land use plan.

Both adverse and beneficial effects of expressways on adjacent areas are discussed, and examples are cited.

The essential purpose of the expressway is to move people and goods, quickly, efficiently, economically, and safely. The functional efficiency of the highway is often impaired by failure to consider emerging land uses induced by the expressway, resulting, in several years, in problems of congestion and insufficient capacity in interchange areas. Examples, both theoretical and actual, are given.

The solution to the major highway-land use problems requires that highway planning be considered on essential part of the comprehensive planning process, not merely related to it. Total community efficiency must be considered, not highway efficiency alone; and total cost to the community, not highway project cost alone.

Specific suggestions to improve highway-land use relationships include:

1. Establishment of service areas removed from general traffic interchanges for use by highway-oriented services and land uses;

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<sup>a</sup> Presented at the October 1959 ASCE Convention at Washington, D. C.

<sup>1</sup> Head, Fred W. Tuemmler and Assocs., Community Planning and Development Consultants, College Park, Md., and Chmn., City Planning Div. Tech. Committee on Land Use Aspects of Highway Location.

2. development of more stringent land use controls and improved techniques of design to regulate access;
3. acquisition of "excess areas" with resale or lease with covenants to protect interchanges and other important access areas;
4. advance acquisition of rights of way through "revolving" or other funds;
5. protection of future rights of way through "reservation" technique;
6. acquisition of development rights and scenic easements; and
7. legislation to prevent accrual of access rights on new highways and to establish a system of benefit assessments to offset unearned increments in land value resulting from mere accident of location.

These and other devices mentioned must be used if there is to be any hope of coping with the highway problems emerging in the latter half of the twentieth century by burgeoning population and accompanying metropolization.

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## INTRODUCTION

1. The effect of an expressway on adjacent land use;
2. the effect of land use on the expressway; and
3. some suggested methods whereby the relationship between expressways and adjacent land use can be brought into balance.

The word *expressways* is intended to include freeways, controlled-access routes and other high-type highways.

## THE EFFECT OF EXPRESSWAYS ON ADJACENT LAND USE

The lines of transportation inevitably determine the patterns of land use and activity, so that whoever plans the location of an expressway is, to a large extent, committing any future land use plan. Thus, patterns of land use in rural and suburban areas within several miles of an expressway will be determined in a large measure by the location of the interchanges, highway service facility areas, service roads, and roads parallel to the expressway. The adverse or beneficial effects of an expressway on a community or rural area can be quite drastic. A new highway crossing an existing route can lead to the creation of a new town or city. The building of an expressway without proper consideration of terminal facilities in an urban area can immeasurably increase the traffic and parking problems of a central business district. Trying to pour the traffic from the terminal of an expressway into inadequate existing city streets is much like trying to pour a bucket of water into a thimble. Locating an expressway through a built-up metropolitan area, especially through high-density areas, can displace as many people as would an urban renewal program.

The Housing Act of 1949 and 1954 makes the relocation of families a prerequisite for Federal participation, but the Federal Highway Act of 1956 omits this responsibility, and the relocation of displaced persons is left as a problem to be solved by the locality. The new interstate highways, by linking the major cities and metropolitan areas and ignoring smaller cities, will undoubtedly result in the continuance of increase in the population of these metropolitan

areas and in the type of strip development connecting some of our larger centers, such as the Washington-Baltimore-Philadelphia-New York-Boston strip in the east, Chicago-Cleveland-Pittsburgh in the middle west, and the California coastal and valley cities, a type of growth that has already been characterized as "megapolis."

By contrast, many of the smaller medium-sized towns not served directly by the interstate highway system are expected by some authorities to suffer a decline in population because of the adverse pull of the megalopolis. However, this prediction may not necessarily be true everywhere. The competitive nature of the United States economy demands that certain industries seek cheaper sources of land and labor, and already there is evidence in some sections of the country that industry is locating away from the big cities, in smaller centers, where land is cheaper, where local labor is more plentiful and does not seek the same high wages that are being demanded in the larger cities, and where there is a good road network leading to several large distribution centers. An example is found in Douglas, Ga., which has good communications with three large areas: the coast towns, the North Florida area, and the Atlanta-Birmingham-Piedmont area.

Some effects of expressways on adjacent land use are bad, others are good. Often, unfortunately, in selecting a route which, from the highway planning point of view, is best in alignment and grade, and least costly, serious faults are committed. Sometimes open areas are invaded that should be reserved for some other use or that are already in or are committed to another use. An elevated route through a residential area may rob it of sunlight and air, causing blight and the diminution of both material and intangible values. In rural districts, a rich agricultural area may be split by a limited-access highway and may thus lose much of its agricultural potential. The location of the highway on upland slopes at a natural division between crops or grazing or forestry might be preferable from the standpoint of agricultural land use to routing it through the center of the valley.

Sometimes community facilities are restricted or impaired by a highway. For example, a large site planned for a hospital may be reduced in size so that it may not be possible to plan adequately for the parking required to serve the hospital facility, with the result that the excess parking is diverted into the surrounding residential streets. Perhaps the hospital facility itself may not be capable of later expansion because of site inadequacy. In other instances, community facilities such as shopping areas, churches, or schools have been severed from the community which they serve. The location and arrangement of overpasses and underpasses can, then, be vital to the continued life and progress of the community.

Another disruptive factor in both rural and urban areas, especially industrial, is the cutting up of property holdings. This can often leave awkward-shaped sites that remain vacant catch-alls for rubbish until they may be incorporated into the development of adjacent property. On occasion, the economy of a community may be disrupted by the destruction of industrial or commercial facilities that provide employment or otherwise benefit the community. Perhaps the highway taking may be the impetus that drives the industry out of the area entirely, thus affecting not only the tax base but the opportunity for continued employment. Thus, from the community's land use standpoint, the adverse effects of poor location with regard to existing and potential land uses may be many times greater than the benefit from the highway or may represent a greater total cost than the initial cost of the highway itself.

The foregoing examples are not given to suggest that these things can always be avoided, and there is no intention of setting up a corral of "sacred cows" whose interests are to override all others, but merely to point out some of the effects an expressway may have on adjacent land uses and to emphasize the need for taking these into consideration and, where possible, to make due allowance and adjustment.

There are many things on the "plus" side of the ledger; for certainly not all of the influences are bad. Properly situated, the expressway may be a separator or barrier between incompatible uses of land, or it may be the catalyst in a redevelopment program through the elimination of a blighted or slum district. Often when done in conjunction with a redevelopment authority, the highway department benefits by acquiring its land at a lower cost than would result if it became involved in the usual condemnation and severance problems, because if the land has been acquired by the urban renewal agency, the highway department may pay only for the right of way it requires.

By taking through traffic out of a congested local area there is a consequent benefit as a result of increased retail sales and a boost in land values along the by-pass roads. True, some of the businesses catering only to highway traffic may suffer, but the record indicates that there is a definite overall and appreciable benefit to the community.

The transition of traffic from one expressway to another and to other highways takes place at interchange points. The location of an interchange affects both locational development and the efficient functioning of the expressway and the highway. It is axiomatic that new roads make new land accessible, and the expressway has tended to put a premium on the points of access. Except where there are frontage roads or service roads, landowners often feel that the land between interchange points no longer provides them with any frontage benefits, whereas land at interchanges has a considerable accretion of benefit because of the concentration of traffic there. However, absence of traffic can, in some circumstances, be a benefit—as for example, to a residential area. This is a factor, incidentally, on the "plus" side of land use planning in relation to expressways. To secure this benefit, it is necessary to plan for adequate depth to the lots immediately adjacent to the expressway and to make definite provisions for planting barriers, especially in cases where the topography or alignment of the highway (as, for example, on a curve) is likely to increase the level of highway noise or the intensity of headlight glare into the adjoining dwellings.

#### THE EFFECTS OF LAND USE ON THE EXPRESSWAY

The essential purpose of an expressway is to move people and goods, quickly, efficiently, economically, and safely. If the functional efficiency of the highway is to be maintained, it is essential that some appraisal be made of the probability of land use along it, especially at the interchange points.

For example, if an interchange proves to be so strategically located as to change the character of the vicinity to the extent that an unimproved area becomes a community and a destination for local and sometimes long-distance travel, the interchange can have a marked effect on the expressway. Of course, the springing up of a community at a crossroad has always been a fundamental characteristic of development. This is how most of our cities began. But now

it is essential to try to foresee such an occurrence and to design expressways and intersecting highways to cope with the traffic volumes which a new center is likely to create. Sometimes, too-closely spaced interchanges can induce what amounts to strip development. They also reduce the capacity of the route, because local traffic using it for short distances creates weaving and congestion problems. More widely-spaced interchanges may encourage a nucleated or clustered development of land use.

As an example of the foregoing, when Route 128 around Boston was planned, little consideration was given to the likelihood of adjacent commercial or industrial development. It was thought that the limited-access characteristics of the belt route would not encourage such development. Instead, surrounding areas have become highly industrialized, which accounts for the fact that the road traffic volume is 2-1/2 times the original estimate. In some areas where the interchanges are close together, there is an obvious reduction in highway efficiency.

Another failure to consider future land uses is shown in Indiana, on the Kokomo and Lebanon bypasses. Although these are not limited-access facilities, they illustrate the point. The building of new residences and businesses, especially at the intersectional areas, have made these bypasses function as neighborhood streets, and through traffic is once again competing with local business and land service traffic.

Intensive development takes place in the interchange areas and roads leading thereto because of the ready accessibility to the expressway. But when there is no access control on the intersecting road or in the interchange area, this shortly becomes cluttered with marginal uses that generate traffic which soon stifles the road so that it is no longer adequate as a traffic-carrying artery. Approaches to the interchange become crowded with long streams of traffic that extend from the congested intersecting road back up the ramps and the decelerating lanes to the expressway itself, and sometimes for a considerable distance along it. Thus, the traffic-carrying capacity of one lane of the expressway is nullified, reducing its efficiency and, of course, its safety. In addition, traffic on the intersecting road has built up to a point where it is hopeless to try to untangle it, and soon there is the quest for a new intersecting road built to controlled-access or limited-access standards. Sometimes the congestion at interchange points is added to by the policy of the highway authority which may not permit the location of gas, food, and other service facilities on the expressway, thus forcing the traveler off at the interchange points. Even in a four-quadrant interchange, this maneuver leads to at least one left-hand or cross-lane movement on a busy highway, adding materially to the already existing hazards.

Congestion at interchange points occurs, too, by continuous frontage roads or interior service roads which meet the intersecting road at the interchange point too close to the ramp connections, and thus much local traffic is mingled with the traffic leaving or preparing to enter the expressway. If these happen to be two-way frontage roads the operational problems at the interchange reach almost impossible proportions. The interchanges themselves are often elaborate systems of grade separation structures, ramp roads, decelerating and accelerating lanes built to accomplish the transition from and to the expressway as quickly, safely and as efficiently as possible. Where the intersecting road is another expressway with similar characteristics, the transition is accomplished in accordance with the design objectives, but from the ex-

amples cited above it can be seen how often this expensive and elaborate system fails because the intersecting road was without control of access in the interchange areas.

#### METHODS OF BALANCING THE RELATIONSHIP BETWEEN EXPRESSWAYS AND ADJACENT LAND USE

Highway planning has often been done independently of general planning. This is particularly true of expressway planning. It occurs because many communities, especially rural areas, have no planning agencies, and even where general planning agencies exist they are frequently unable, because of staff limitations or different concepts of the timetable of events to met the requirements or to cope with the highway planner who has a deadline to meet. These deadlines are usually due to the disappearance at certain dates of funds that are not committed. There is abundant evidence to support this.

The highway engineer planning an expressway generally locates it to serve a desire line based on an origin and destination survey or other type of traffic analysis, and seeks to achieve the most economical and efficient route. Economy and efficiency are, however, thought of in terms of the expressway, its traffic, the traffic-generating area it will serve, and the actual cost of producing the physical structure. It is not usually related to the total economy of the area traversed. In the past and in some places, unfortunately, even today, there is a compartmentalization of highway and general planning, a lack of contact. This unhappy situation has been corrected in many places and today there are more and more examples, especially in metropolitan areas where planning and redevelopment agencies exist, where good cooperation occurs between the highway planner and the city planner. Advantage is taken to locate a route with important or emerging land use factors in mind and to achieve the maximum benefit for both the highway user and the community. But primarily, the highway planner in the past has considered transportation planning as merely related to comprehensive planning whereas the city or regional planner necessarily views highway planning as an integral part of comprehensive planning. Considering the interrelated effect that expressways and land use have on one another, two principles are apparent; that, in looking at the locational aspects of expressways, total community efficiency must be considered rather than highway efficiency alone, and that the total cost to the community must be considered rather than the cost of the highway project alone. Thus, if a park is to be destroyed, is there other vacant land available in the area for replacement and can it be obtained at a cost justifying the initial violation? Or is the total cost so much higher that it would have been better to change the location of the highway, perhaps increasing its cost but reducing the total cost?

Again, the relative costs of access control and condemnation and of building a service road should not be the deciding factor for or against a particular service road, nor should the minor expense involved for access rights be the prime determinant in the use of perhaps several hundred acres along the expressway. If total community efficiency is to be analyzed and appraised and the resultant plan based on it, it necessarily implies a degree of collaboration between highway planner and city and regional planner that thusfar has not been achieved. It is strange indeed that the federal government, which requires a "workable program," including a master plan, from a locality as a prerequisite

for disbursement of federal funds for urban renewal programs, failed to insure adequate cooperation between highway planners and city and regional planners before federal funds were committed to the highway programs. It has been suggested that, had such a requirement been written into the 1956 Highway Act, the lack of existing planning agencies through much of the areas to be traversed would have caused serious delays in the program. This is probably true, but looking into the future the question arises of whether or not, without consideration of all the factors, the highway building program in the long run will compound more problems than it may solve. More and more highway people are reaching the conclusion that lack of coordinated planning has also contributed to delay after a location was selected. In every instance of the proposed bypassing of a city, the highway planner is called on to defend his location. How much better off he would be if he had the advantage of having a united front with the city or regional planner to answer those questions which arise when embattled citizenry descends en masse with the sole intent and purpose of eradicating the proposals of a highway plan.

Although it should have been done initially, it is not too late to write into both the federal and state laws the requirements of a master plan reflecting the combined studies of city and regional planners and highway planners as a prior requisite to the disbursement of highway funds. This suggestion takes into account the fact that there has been great progress made in the last few years in many aspects of planning as it relates to land use and transportation. A good deal of the research that has been done has revealed that it is not only possible to express travel behavior of people with mathematical formulae but also to forecast land use patterns. Land use models which are described as "mathematical statements of observed relationships" deal with the relationships of land use and are used to determine the changes of land use patterns, and on the basis of predicted increases in population to estimate the probable distribution of population and employment at some target date in the future. A study of land use and traffic models has been presented elsewhere.<sup>2</sup>

The following are specific recommendations regarding the expressway-land use relationship. With respect to those land uses that are strictly expressway-oriented, it appears entirely reasonable to acquire extra land in order to provide these service facilities with access directly from the expressway outside of the interchange areas. A master plan could indicate where these facilities should be located and the amount of land required. Each service facility area could be planned and engineered as an integral part of the expressway with considerable setbacks, service interchanges with accelerating and decelerating lanes, etc., and the land available for the facilities themselves could be leased or sold with lease restrictions running with the land. Thus, highway-oriented activities such as filling stations, restaurants (which, incidentally, might have as an ancillary aspect drug counters to meet the incidental needs of the traveling public) and motor hotels could be largely away from the interchange areas, leaving these for the community-oriented activities. The highway service areas also could be used by merchants, hotels, and other businesses in nearby communities as places to advertise their wares or services, and even national advertising, with limitation as to extent, location, and size, could be allocated space.

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<sup>2</sup> "Land Use and Traffic Models," by Alan M. Voorhees (editor), *Journal, Amer. Inst. of Planners*, Vol. XXV, No. 2, May, 1959.

Most of us are familiar with the land use controls available through zoning and subdivision regulation. In areas and communities where these have been carefully prepared in accordance with a comprehensive plan and where there is good administration of these tools, they can be very effective in achieving the objectives of land use control and in attaining a greater degree of compatibility between the expressway and surrounding land uses. In an access control study in Maryland,<sup>3</sup> amendments to a local subdivision ordinance have been proposed to provide for a reverse-frontage arrangement of lots in residential properties bordering an expressway, with an intervening "public reservation strip" over which the owners of abutting property would have no right of access. Also proposed is the elimination or temporary access points at such time as alternative inter-community circulation is improved to provide for adequate circulation without invasion of the expressway. The reason for the latter provision is that this study involves the upgrading of an existing major highway to future expressway standards.

Where they exist, the intensity of land uses depends on the zoning ordinance and its administration. Unfortunately, the competition for land is so great that pressure for change in land use in preferred spots is often well-nigh irresistible, especially when harassed local governments realize that a new commercial or industrial development will enhance the community's assessable base, thereby bringing funds for much-needed schools and other community facilities.

The zoning changes made after the development of Route 128 around Boston are a good example of such pressures. In the Washington D. C. area similar changes, from rural to industrial use, have been experienced in some of the interchange areas along the Washington National Pike in Montgomery County. To avoid over-congestion in interchange areas, particularly along uncontrolled sections of intersecting highways, it is important for the agency having jurisdiction to adopt a land use policy which spreads some of the development away from the immediate interchange areas.

Economic studies of expressways in California, Connecticut, and elsewhere indicate that businesses and land values of land fronting on expressways benefit as much as those near interchanges. For some businesses the advantage lies in the advertising value of being seen from the expressway; to others, in the greater quietness than being directly on the much-traveled intersecting road.

Depending on the type of land use plan, service roadways may front directly on the expressway or be removed from it so that the adjacent development backs into the expressway. In planning or sanctioning service roads, especially where these are part of a large industrial or commercial park development, two points should be considered: that of providing an occasional single-directional road with access from the expressway but without crossovers, and that of orienting the ends of the service road so that these reach an intersecting road at a considerable distance from an interchange point on the expressway. This would give the development maximum use of the expressway with the least interruption to its traffic and would insure that locally-oriented traffic would enter local roads well away from the interchange areas.

Of course, in the final analysis, the most positive way to insure control is by outright acquisition of the right of access. This is thought of, generally, as being very costly. While it is often so at the time, it need not be so in the long

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<sup>3</sup> "Access Control Study," New Columbia Pike (U. S. Route 29) State Rds. Comm. of Md., Baltimore, Md.

run. New York State's constitution empowers, in certain cases, excess condemnation with the right to "improve and utilize such excess areas wholly or partly for any other public purpose" or (and this is important) "to lease or sell such excess area with restrictions to preserve and protect such improvements." Under this law it is possible to achieve considerable control and at the same time the highway agency might, because of enhanced land values created by the expressway, recoup more than was originally spent on the acquisition of the extra land.

California has kept the cost of acquisition down by establishing a \$30,000,000 revolving fund for such purposes and has estimated a saving of \$15 for every \$1 invested because the purchases were made in advance of rising land costs. Seven states have similar funds.

Another method used in New York City and in several of the Maryland counties is the reservation technique, whereby land for highway purposes is reserved for several years in advance of acquisition, thereby preventing the erection of improvements which would have to be purchased later. New York State has had some success with the "official map" as a device for protecting future rights of way.

Another means used to protect the highway marginal areas against the intrusive aspects of development is to acquire something less than full fee-simple title. For example, in suburban and other outlying areas where the expressway is planned to go through open and sometimes farm land, it should be possible, at the time of acquisition of right-of-way for the expressway, to acquire development rights along the intersecting roads for a reasonable distance from the interchange point itself.

The State of Wisconsin already uses, particularly on improved state trunk highways, the method of acquiring partial or complete access rights from adjacent owners by agreement and under eminent domain. This enables individual parcels to be acquired without the time-consuming proceedings necessary to establish controlled access, and such land is in addition to the mileage limitation imposed by Wisconsin's controlled-access highway statute. It enables the number of driveways to be restricted to those required for present and potential uses and establishes now on acceptable pattern of access to the highway for the future.

Maryland acquires roadside easements by condemnation, but finds the cost nearly as high as outright acquisition because juries have given awards based upon what has been termed the "development potentiality" of marginal areas. In many instances these have been farms or other open lands which normally would remain in that category for many years to come. On the other hand, in the State of Ohio they have been acquiring similar easements called "reservation rights" by negotiation, not condemnation, at remarkably less cost.

In these two states the intention is to prevent future blight, but easements have been acquired purely to protect scenery, as, for example, along the New York Thruway, the Saint Lawrence River, and the Blue Ridge Parkway; or, as in California, in the Bay Circuit area, to keep land open as farmland, golf courses, and so on. In 1959, the California legislature passed an act authorizing the acquisition of "the fee or any lesser interest or right in real property to acquire, maintain, improve, protect and limit the future use of or otherwise conserve open spaces, "declaring that such acquisition constitutes a public purpose for which public funds may be expended or advanced. It further

authorizes the acquisition of any "development right, easement, covenant or other contractual right necessary to achieve the purpose as well as the conveying or leasing back of property acquired under such covenants or other contractual arrangements as will limit the future use of the property to achieve the purposes stated."

Since 1947, Oregon has developed a system of access control based on the theory that access rights can be acquired and conveyed and limited as to purpose. Access control is achieved by controlling the use that can be made of approaches to a highway. A residential use access, for example, cannot later be used for industry or commerce. This has saved the State considerable sums of money as there have been many cases where some limitation of marginal use but not complete control of access was necessary.

From the highway agency's point of view, the buying of easements may add appreciably to the cost of acquisition, but it is positive insurance regarding the longevity of highway usefulness if past experience on the intersecting roads is a criterion of subsequent development without such controls. On the other hand, the community concerned with land use control is equally interested in a stable land use pattern and it, too, might be a participant in the acquisition of development rights or rights in land.

The development rights could be so devised that their acquisition does not nullify marginal development but would regulate it to restrict points of access, to arrange and distribute the intensity of land use so that maximum benefits in land use and economic stability could be achieved, and to prevent mushroom growth of roadside eyesores and the creation of new highway slums. The right of the community to acquire land for public purposes is established beyond question. The only question that may arise in some minds is whether or not the acquisition of development rights in the instance mentioned serves a public purpose.

In 1945, the Supreme Court ruled that "the concept of public welfare is broad and inclusive. It is within the power of the legislature to determine that the community should be beautiful as well as healthy, spacious as well as clean, and well-balanced as well as carefully-patrolled." A law has been promulgated that signs along expressways should be controlled as a matter of public interest. Surely the forestalling of blight, the safety of road users, the prevention of congestion at interchanges and the maintenance of the efficiency of the highway as well as the creation of sound land use patterns are even more important to the public interest.

The acquisition of such development rights would serve a two-fold public purpose. First, the acquisition of development rights or rights in land along a major highway in the vicinity of interchanges would preserve the integrity of the highway and maintain it at the high level for which it was proposed, designed, and built. It is essential to protect the gigantic investment of public money used to provide for the fluid movement of persons and goods, and keeping the highways free of the deleterious effects of marginal development is a vital method of protection. Second, it will mean that the location of an interchange at a particular intersecting road will inure to the benefit of the general public rather than to that of a specific owner whose land value is enhanced by proximity to the interchange at the expense of other properties not so fortunately located, from an economic standpoint.

The expressway is for the benefit of all the public, for all the people who use it for travel and the transportation of goods. Therefore, whatever benefits are derived should be dispensed with the broad public good in mind. It should be

added that it also benefits the owner of property close to an interchange, for if under the "laissez faire" system his property is developed, than his neighbor's, and eventually all the properties along the road, the highway will soon become so congested that early functional obsolescence will set in and there will be need for a replacement road. Then his property and that of others may be left to suffer the economic doldrums resulting from the movement of traffic to the new highway. This, of course, is not true in areas where there has arisen a strong local community supporting the highway-oriented enterprises; but in many instances, businesses in the vicinity of an interchange are entirely dependent on the traveler for trade, and these are the ones that will suffer. Furthermore, the need for relocating the highway will disrupt other established uses, by bringing through their midst a new facility that will necessitate adjustment or alteration in the established pattern of the community and its life and order.

With these two goals in mind of maintaining 1. the highest possible level of highway safety and efficiency and 2. the highest possible land use stability, from the standpoints of both economic stability and land use compatibility, it seems that the arguments are clearly in favor of strengthened controls.

### CONCLUSIONS

To achieve a high degree of expressway-land use compatibility, it appears essential to:<sup>4</sup>

1. Add to the existing controls in zoning and subdivision regulations;
2. require comprehensive planning in order to achieve the best and most reasonable system and pattern of land uses adjacent to the expressways and particularly in the interchange areas.
3. invoke legislation to prevent accrual of access rights when new expressways and other state highways are built;
4. add to existing rights to control access along intersecting roads for at least a half-mile and perhaps up to a mile from expressway interchanges;
5. establish and exercise fully the right to acquire development rights wholly or partially in land adjacent to expressways and along state and county highways; and
6. perhaps establish a benefit assessment on those whose property, through mere accident of location, enjoys an accelerated economic advantage which establishes a premium land value and to which the public, through its highway program, has been a silent underwriting partner.

As the nations population increases and more and more metropolization occurs, the need for greater controls in land use and in the location of highways and interchanges will be evermore felt. With the population burgeoning and its distribution over vast areas of hitherto inaccessible land, there will be changes never foreseen. It seems justifiable, therefore, to consider as vital the exercise of these extra controls stringent though they may seem now, while there is yet time.

Perhaps it was for those of us facing the latter years of the twentieth century that the prophet Isaiah gave these warning words: "Woe unto them that join house to house, that lay field to field, 'til there be no place that they may be placed alone in the midst of the earth. Of a truth, many houses shall be desolate, even great and fair, without inhabitant."<sup>4</sup>

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<sup>4</sup> Isaiah 5:8-9.



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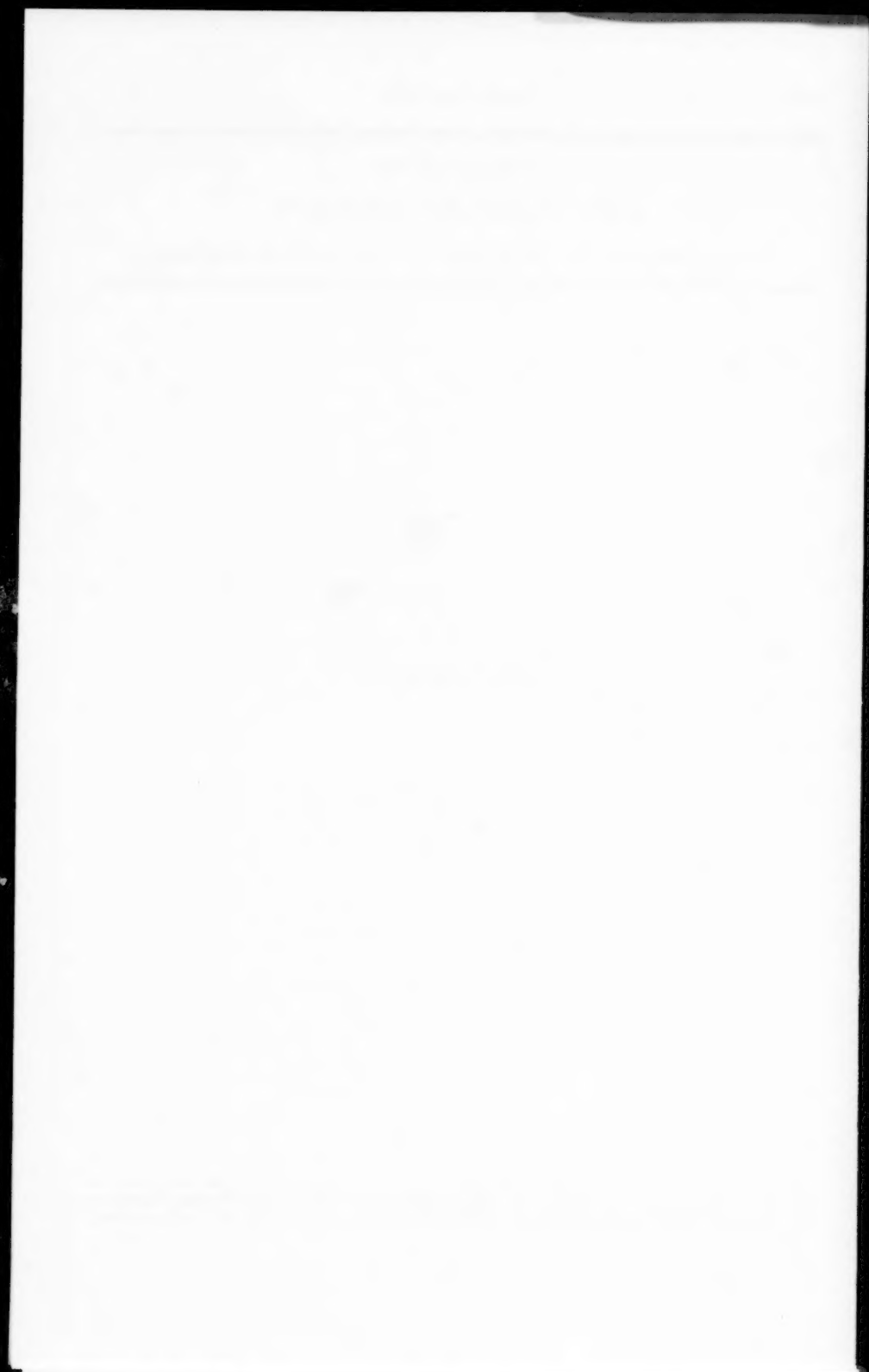
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DISCUSSION

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COORDINATING PUBLIC WORKS AND URBAN RENEWAL  
IN KANSAS CITY, KANSAS<sup>a</sup>

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Closure by Eldridge Lovelace and Ramon Duran

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ELDRIDGE LOVELACE,<sup>1</sup> F. ASCE and RAMON DURAN.<sup>2</sup>—C. E. Doell, F. ASCE in his discussion, raises an interesting and important question, one that might well form the subject of an entire paper.

Certainly it is inadvisable, as Doell suggests, to back houses on parks rather than to front them on a park with a street in between. Experience with the "interior block playground," an arrangement that seems so good in theory but that works out so poorly in practice, is ample demonstration of the soundness of Doell's position. In the Kansas City, Kan. project the slopes were so steep as to make the violation of the principle the preferred solution. This should have been explained in more detail in the original article.

One should, however, view with some alarm, recent articles in architectural magazines, "beating the drums" for Radburn-type housing layouts in which there are many instances in which houses back on parks. If many (or any) of these schemes are conducted, the difficulties cited by Doell can be expected to occur again.

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<sup>a</sup> December 1959, by Eldridge Lovelace and Ramon Duran (Proc. Paper 2307).

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# PROCEEDINGS PAPERS

The technical papers published in the past year are identified by number below. Technical-division sponsorship is indicated by an abbreviation at the end of each Paper Number, the symbols referring to: Air Transport (AT), City Planning (CP), Construction (CO), Engineering Mechanics (EM), Highway (HW), Hydraulics (HY), Irrigation and Drainage (IR), Pipeline (PL), Power (PO), Sanitary Engineering (SA), Soil Mechanics and Foundations (SM), Structural (ST), Surveying and Mapping (SU), and Waterways and Harbors (WW), divisions. Papers sponsored by the Department of Conditions of Practice are identified by the symbols (PP). For titles and order coupons, refer to the appropriate issue of "Civil Engineering." Beginning with Volume 82 (January 1956) papers were published in Journals of the various Technical Divisions. To locate papers in the Journals, the symbols after the paper number are followed by a numeral designating the issue of a particular Journal in which the paper appeared. For example, Paper 2703 is identified as 2703(ST1) which indicates that the paper is contained in the first issue of the Journal of the Structural Division during 1961.

## VOLUME 86 (1960)

SEPTEMBER: 2588(IR3), 2589(IR3), 2590(WW3), 2591(IR3), 2592(HW3), 2593(IR3), 2594(IR3), 2595(IR3), 2596(HW3), 2597(WW3), 2598(IR3), 2599(WW3), 2600(WW3), 2601(WW3), 2602(WW3), 2603(WW3), 2604(HW3), 2605(SA5), 2606(WW3), 2607(SA5), 2608(ST9), 2609(SA5)<sup>c</sup>, 2610(IR3), 2611(WW3)<sup>c</sup>, 2612(ST9)<sup>c</sup>, 2613(IR3)<sup>c</sup>, 2614(HW3)<sup>c</sup>.  
OCTOBER: 2615(EM5), 2616(EM5), 2617(ST10), 2618(SM5), 2619(EM5), 2620(EM5), 2621(ST10), 2622(EM5), 2623(SM5), 2624(EM5), 2625(SM5), 2626(SM5), 2627(EM5), 2628(EM5), 2629(ST10), 2630(ST10), 2631(PO5)<sup>c</sup>, 2632(EM5)<sup>c</sup>, 2633(ST10), 2634(ST10), 2635(ST10)<sup>c</sup>, 2636(SM5)<sup>c</sup>.  
NOVEMBER: 2637(ST11), 2638(ST11), 2639(CO3), 2640(ST11), 2641(SA6), 2642(WW4), 2643(ST11), 2644(HY9), 2645(ST11), 2646(HY9), 2647(WW4), 2648(WW4), 2649(WW4), 2650(ST11), 2651(CO3), 2652(HY9), 2653(HY9), 2654(ST11), 2655(HY9), 2656(HY9), 2657(SA6), 2658(WW4), 2659(WW4)<sup>c</sup>, 2660(SA6), 2661(CO3), 2662(CO3), 2663(SA6), 2664(CO3)<sup>c</sup>, 2665(HY9)<sup>c</sup>, 2666(SA6)<sup>c</sup>, 2667(ST11)<sup>c</sup>.  
DECEMBER: 2668(ST12), 2669(IR4), 2670(SM6), 2671(IR4), 2672(IR4), 2673(IR4), 2674(ST12), 2675(EM6), 2676(IR4), 2677(HW4), 2678(ST12), 2679(EM6), 2680(ST12), 2681(SM6), 2682(IR4), 2683(SM6), 2684(SM6), 2685(IR4), 2686(EM6), 2687(EM6), 2688(EM6), 2689(EM6), 2690(EM6), 2691(EM6)<sup>c</sup>, 2692(ST12), 2693(ST12), 2694(HW4)<sup>c</sup>, 2695(IR4)<sup>c</sup>, 2696(SM6)<sup>c</sup>, 2697(ST12)<sup>c</sup>.

## VOLUME 87 (1961)

JANUARY: 2698(PP1), 2699(PP1), 2700(HY1), 2701(SA1), 2702(SU1), 2703(ST1), 2704(ST1), 2705(SU1), 2706(HY1), 2707(HY1), 2708(HY1), 2709(PO1), 2710(HY1), 2711(HY1), 2712(ST1), 2713(HY1), 2714(PO1), 2715(ST1), 2716(HY1), 2717(SA1), 2718(SA1), 2719(SU1)<sup>c</sup>, 2720(SA1)<sup>c</sup>, 2721(ST1), 2722(PP1)<sup>c</sup>, 2723(PO1)<sup>c</sup>, 2724(HY1)<sup>c</sup>, 2725(ST1)<sup>c</sup>.  
FEBRUARY: 2726(WW1), 2727(EM1), 2728(EM1), 2729(WW1), 2730(WW1), 2731(EM1), 2732(SM1), 2733(WW1), 2734(SM1), 2735(EM1), 2736(EM1), 2737(PL1), 2738(PL1), 2739(PL1), 2740(PL1), 2741(EM1), 2742(ST2), 2743(EM1), 2744(WW1), 2745(WW1), 2746(SM1), 2747(WW1), 2748(EM1), 2749(WW1), 2750(WW1)<sup>c</sup>, 2751(EM1)<sup>c</sup>, 2752(SM1)<sup>c</sup>, 2753(PL1)<sup>c</sup>, 2754(ST2)<sup>c</sup>, 2755(PL1).  
MARCH: 2756(HY2), 2757(IR1), 2758(AT1), 2759(CO1), 2760(HY2), 2761(IR1), 2762(IR1), 2763(HY2), 2764(ST3), 2765(HY2), 2766(HW1), 2767(SA2), 2768(CO1), 2769(IR1), 2770(HY2), 2771(SA2), 2772(HY2), 2773(CO1), 2774(AT1), 2775(IR1), 2776(HY2), 2777(HY2), 2778(SA2), 2779(ST3), 2780(HY2), 2781(HY2)<sup>c</sup>, 2782(HW1)<sup>c</sup>, 2783(SA2)<sup>c</sup>, 2784(CO1), 2785(CO1)<sup>c</sup>, 2786(IR1)<sup>c</sup>, 2787(ST3)<sup>c</sup>, 2788(AT1)<sup>c</sup>, 2789(HW1).  
APRIL: 2790(EM2), 2791(SM2), 2792(SM2), 2793(SM2), 2794(SM2), 2795(SM2), 2796(SM2), 2797(SM2), 2798(EM2), 2799(EM2), 2800(EM2), 2801(EM2), 2802(ST4), 2803(EM2)<sup>c</sup>, 2804(SM2)<sup>c</sup>, 2805(ST4)<sup>c</sup>.  
MAY: 2806(SA3), 2807(WW2), 2808(HY3), 2809(WW2), 2810(HY3), 2811(WW2), 2812(HY3), 2813(WW2), 2814(HY3), 2815(WW2), 2816(HY3), 2817(HY3), 2818(SA3), 2819(WW2), 2820(SA3), 2821(WW2), 2822(WW2)<sup>c</sup>, 2823(HY3), 2824(SA3), 2825(HY3), 2826(SA3)<sup>c</sup>, 2827(HY3)<sup>c</sup>.  
JUNE: 2828(SM3), 2829(EM3), 2830(EM3), 2831(IR2), 2832(SM3), 2833(HW2), 2834(IR2), 2835(EM3), 2836(IR2), 2837(IR2), 2838(SM3), 2839(SM3)<sup>c</sup>, 2840(IR2)<sup>c</sup>, 2841(HW2)<sup>c</sup>, 2842(EM3)<sup>c</sup>, 2843(ST5), 2844(ST5), 2845(ST5), 2846(ST5)<sup>c</sup>.  
JULY: 2847(PO2), 2848(SU2), 2849(HY4), 2850(PO2), 2851(HY4), 2852(PO2), 2853(SU2), 2854(HY4), 2855(PO2), 2856(PO2), 2857(PO2), 2858(SA4), 2859(SU2), 2860(SA4), 2861(PO2), 2862(SA4), 2863(HY4), 2864(HY4), 2865(HY4), 2866(HY4), 2867(HY4), 2868(PO2)<sup>c</sup>, 2869(SA4)<sup>c</sup>, 2870(SU2)<sup>c</sup>, 2871(HY4), 2872(HY4)<sup>c</sup>, 2873(SU2), 2874(SA4).  
AUGUST: 2875(WW3), 2876(WW3), 2877(WW3), 2878(SM4), 2879(ST6), 2880(EM4), 2881(SM4), 2882(EM4), 2883(WW3), 2884(EM4), 2885(SM4), 2886(WW3), 2887(EM4), 2888(WW3), 2889(AT2), 2890(AT2), 2891(AT2), 2892(AT2), 2893(AT2), 2894(AT2), 2895(AT2), 2896(AT2), 2897(AT2), 2898(AT2), 2899(AT2), 2900(AT2), 2901(AT2), 2902(SM4), 2903(ST6), 2904(ST6), 2905(SM4), 2906(ST6), 2907(EM4), 2908(ST6), 2909(EM4), 2910(ST6), 2911(EM4), 2912(SM4), 2913(ST6), 2914(WW3)<sup>c</sup>, 2915(ST6)<sup>c</sup>, 2916(EM4)<sup>c</sup>, 2917(SM4)<sup>c</sup>.  
SEPTEMBER: 2918(SA5)<sup>c</sup>, 2919(HW3)<sup>c</sup>, 2920(HY5)<sup>c</sup>, 2921(SA5), 2922(PL2), 2923(IR3), 2924(HY5), 2925(HY5), 2926(CP1), 2927(HY5), 2928(IR3), 2929(IR3), 2930(HY5), 2931(CP1), 2932(PL2), 2933(HY5), 2934(HY5), 2935(HY5), 2936(HY5), 2937(HW3), 2938(CP1), 2939(PL2), 2940(SA5), 2941(SA5), 2942(SA5), 2943(HY5), 2944(PL2)<sup>c</sup>, 2945(CP1)<sup>c</sup>, 2946(IR3), 2947(HW3), 2948(IR3), 2949(IR3)<sup>c</sup>.

c. Discussion of several papers, grouped by divisions.

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